November 23, 1998
NRA 98-HEDS-04
OMB Approval No. 2700-0042

National Aeronautics and Space Administration

Research Announcement

Research Opportunities in Biology-Inspired Technologies

1998

A Research Announcement for the
Office of Life and Microgravity Sciences and Applications

Letters of Intent Due:	**December 15, 1998**
Proposals Due:	**February 3, 1999**

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NASA Research Announcement

Research Opportunities in Biology-Inspired Technologies

The National Aeronautics and Space Administration (NASA) is embarking upon a bold initiative whose focus is to develop technologies of wide functional reach which are derived from and inspired by biology in order to empower humans in space as well as on Earth. The NASA Office of Life and Microgravity Sciences and Applications has accepted stewardship of this endeavor.

Affordable and productive human presence in space for long durations will require human empowerment technologies which are beyond the present state-of-the-art. It is envisioned that what will be needed will be a seamless human-machine partnership where the strengths of each complement and blend with one another. To vitalize this human-machine interaction, we will necessarily have to look towards biology as our central guiding principle of design, since these systems will require a high degree of effortless adaptation to a changing and dynamic environment. A central focus is to design systems which significantly improve operational safety in a hostile environment.

This NASA Research Announcement (NRA) is intended to solicit innovative and "out of the box" concepts, which are largely inspired by biology, and the demonstration of the proof of such concepts. It is expected, therefore, that such proposals may contain some risk of failure.

Details concerning this Announcement and the preparation of proposals in response to this Announcement are included in the attached appendices.

- Appendix A provides technical information about Biology-Inspired Technologies and other information that is applicable only to this Announcement.
- Appendix B contains detailed instructions for this specific NRA and includes the relevant application forms.
- Appendix C contains general instructions applicable to the preparation of proposals in response to NASA Research Announcements.

Proposals submitted in response to this Announcement are for ground-based research, and may be for activities lasting up to three years. Proposals will be evaluated by an independent peer-review panel for overall scientific or technical value. Innovativeness, such as leveraging off recent advances in biological technologies, and potential for non-NASA applications will also be considered. Relevance to NASA's programmatic needs and goals and the feasibility of implementation (where relevant) will be evaluated separately by NASA. See Appendix A, Section IV for more details on proposal evaluation.

A selection announcement will be made in May 1999. Funding of selected ground-based proposals will begin in June 1999. The government's obligation to make awards is contingent upon the availability of appropriated funds from which payment for award purposes can be made, and the receipt of proposals that the government determines are acceptable for award under this NRA. It is anticipated that approximately 25 awards averaging $150,000 (total annual costs) will be made. Requests for support may vary from $15,000 to $350,000.

Proposers should note that, because the selection process will include an evaluation of the cost-effectiveness of each potential project, proposals that request substantially higher amounts of support may be at a disadvantage if the higher budget request is not adequately justified.

Participation in this Announcement is open to all categories of domestic and foreign organizations, industry, educational institutions, other nonprofit organizations, NASA laboratories, and other government agencies. Proposals that enhance or complement the scientific return from research currently being supported by industry or other government agencies are encouraged. **Though, under certain circumstances, NASA will review proposals from non-U.S. institutions, NASA does not fund non-U.S. institutions** (see Appendix A, Section V, Part C of this Announcement for details).

A letter of intent (LOI) to propose is requested by December 15, 1998 by 4:30 PM EST (see Appendix A, Section V, Part F of this Announcement). LOIs should be submitted via the World-Wide-Web (WWW) at:

http://peer1.idi.usra.edu/expro/loi/98_HEDS_04_loi.cfn

If you do not have access to the WWW, you may submit an LOI via e-mail to:

loi@hq.nasa.gov

The subject heading of the e-mail message should read "LOI NRA 98-HEDS-04."
If you do not have access to e-mail, you may submit an LOI by U.S. Postal Service or commercial delivery to the address below.

Proposals may not be submitted electronically. Proposals must be received by February 3, 1999 by 4:30 PM EST. Proposals and LOIs mailed through the U.S. Postal Service by express, first class, registered, or certified mail are to be sent to the following address:

NASA c/o Information Dynamics, Inc.
SUBJECT: NASA OLMSA Research Proposal
300 D Street, SW
Suite 801
Washington, DC 20024

Proposals and LOIs that are hand delivered or sent by commercial delivery or courier services are to be delivered to the above address between 8:00 AM and 4:30 PM EST. The telephone number, 202-479-2609, may be used when required for reference by delivery services. Information Dynamics, Inc. (IDI) cannot receive deliveries on Saturdays, Sundays, or Federal holidays. Upon receiving a proposal, IDI will send a postcard to the proposer confirming its arrival.

In order to be accepted as a complete submission, proposals **must include** completed copies of the appropriate forms provided in Appendix B. Special instructions apply to proposals by institutions which are not entities of the United States (see Appendix A, Section V, Part C of this Announcement).

The following items apply only to this Announcement:

Solicitation Announcement Identifier:	NRA 98-HEDS-04
Number of Proposal Copies Required:	Original + 25 copies

Letters of Intent Due:	December 15, 1998
Proposals Due:	February 3, 1999
Selecting Official:	Associate Administrator Office of Life and Microgravity Sciences and Applications
Additional Programmatic Information:	Roger Crouch, Ph.D. NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0689 Fax: (202) 358-4174

Potential proposers should carefully read the attached Appendices, and focus their proposals on the specific research emphases defined in this Announcement.

Your interest and cooperation in participating in this effort is appreciated.

Original Signed by:

Arnauld E. Nicogossian, M.D.
Associate Administrator for
Life and Microgravity Sciences and Applications

APPENDIX A
NRA 98-HEDS-04

Research Opportunities in Biology-Inspired Technologies

I. Introduction

The Office of Life and Microgravity Sciences and Applications (OLMSA) of the National Aeronautics and Space Administration (NASA) seeks proposals in Biology-Inspired Technologies in support of the Human Exploration and Development of Space (HEDS) Enterprise. This Announcement solicits scientific and technical proposals to be funded beginning in Fiscal Year 1999. Proposals for research and technology development in areas outside those defined in this Announcement will be rejected or returned to the proposer without review. However, NASA reserves the right to act in the best interests of the Federal Government in the matter of acceptance for evaluation.

All proposers responding to this NASA Research Announcement need to quantify the benefits of their work to NASA in terms of minimization of mass, power and crew time utilized, increased system reliability, safety, etc., for present or future missions.

One of the stated goals of the HEDS Enterprise is "to share HEDS knowledge, technologies, and assets that promise to enhance the quality of life on Earth." Therefore, individuals participating in this NRA are expected to help foster the development of a scientifically informed and aware public. Supported investigators, in collaboration with NASA, will be expected to produce a plan for communicating their work to the public.

NASA has a strong commitment to the ethical treatment of human and animal research subjects. Assurance of compliance with Federal regulations regarding human subjects and/or animal care and use is required as part of the proposal submission process (see the "Special Matters" instructions in Appendix B of this Announcement). Applicants should note that review of a proposal is not guaranteed if the required information is not supplied.

II. Proposal Types

This research announcement solicits only ground-based proposals for basic research, technology readiness levels one through three (see A-11, section H). A proposal may involve multidisciplinary or interdisciplinary research teams, and the benefits of the teaming should be clearly stated in the proposal. Proposals should include a well-defined research plan that can be accomplished within three years**.**

III. Biology-Inspired Technology

The 3.8 billion-year-old tinkering of the Earth's biological machinery, which has been fueled by necessity, has endowed it with extraordinary attributes in terms of fault tolerance via self-repair (DNA-repair), self-replication (cell division), self-assembly (membrane formation), and information processing, all of which are derived from a small finite set of chemicals in the environment and require a minimal expenditure of energy. Furthermore, this complex machinery does impressively rapid information processing, at a nanoscale level, with meager investments of energy. A hallmark of biological evolution is its ability to adapt to unforeseen contingencies as well as maintaining homeostasis through a cascade of feedback and feedforward controls. In the last two decades, major advances in cell and molecular biology have begun to give us insight into the mechanisms underlying biological functions. Such an understanding of biological processes allows us to explore, in an unprecedented way, the possibilities of capitilizing on biology to design and develop technologies based on these processes.

Affordable and productive human presence in space for long durations will require human empowerment technologies, which are beyond the present state-of-the-art. It is envisioned that what will be needed will be a seamless human-machine partnership where the strengths of each would complement and blend with one another. To vitalize this human-machine interaction, we will necessarily have to look towards biology as our central guiding principle of design since these systems will require a high degree of effortless adaptation to a changing and dynamic environment. A central focus is to design systems which significantly improve operational safety in a hostile environment.

This NASA Research Announcement (NRA) is intended to solicit innovative and "out-of-the-box" technology concepts largely inspired by biology, and the demonstration of the proof of such concepts. It is expected, therefore, that such proposals may contain some risk of failure.

Elements of the NRA The NRA will mainly focus on two general areas:

1. Smart Materials and Structures Inspired by Biology
2. Human-Centered Systems

A. Smart Materials and Structures Inspired by Biology

A recent National Research Council (NRC) report on biomaterials ("Biomolecular Self-Assembling Materials," Panel on Biomolecular Materials, National Academy Press, 1996) has concluded that the time is ripe for the development of a physical understanding of the complex but exquisite behaviors manifested by biological systems including recognition and response, self-assembly, and self-repair. These principles extended to the synthesis of modern materials should lead to new materials and processes with a broad range of technological impact. The need for pursuing novel approaches to materials design rests with the problems inherent to current materials design, i.e., that structures and materials are designed for worst-case scenarios and hence are provided with large margins of safety. This calls for numerous reinforcements, redundant sub-units, and back-up systems, which add both weight and power requirements. Hence, what is needed are "intelligent" materials and structures that, like living systems, provide diagnosis, prognosis, adaptive behavior, and/or self-repair.

At the same time, future human space exploration is envisioned as a deep symbiosis between the human explorer and a network of smart survivable space sensor systems of variable autonomy. Current space systems have lifetimes of a few years and can cope with only modestly harsh environments. Future missions will require space systems of unprecedented life times (a few

decades to a century), possessing onboard acumen and automated self-assessment and self-reconfiguration functions. The systems must be able to adapt performance to environmental conditions and recognize and focus on "interesting" data.

Achieving these systems requires bold new research efforts designed to borrow from nature's secrets from nanoscale (subcellular) to macroscale (organismal), and emulate biological solutions to sensory perception, communication, adaptation, and motor control. Intelligent autonomous systems will need to learn from their interactions with their environment and adapt appropriately in real time. Like biological systems, these future autonomous systems will incorporate significant capability at the microscopic level (i.e., healing of wounds or changing skin color) through structures which are themselves organized at nanoscale. Nanoscale structures such as carbon nanotubes may enable materials, which are stronger, - may store power or hydrogen, and - may act as signal relays for adsorbates for chemical sensor applications. By coupling biologically inspired neurotechnology with model-based reasoning, hybrid systems are envisioned that will use symbolic deductive methods to help coordinate and direct a collection of these adaptive methods. NASA is soliciting proposals for research and the development of technologies that will demonstrate some or all of the following attributes:

1. Anticipatory (ability to anticipate future events on basis of current data)
2. Collaborative (ability to cooperate with other systems)
3. Curious (motivation to explore, investigate, and discover)
4. Self-modeling (ability to reason about its own changing status)
5. Adaptive (functionality change over time to meet changing needs)
6. Self-Repairing (ability to reconfigure and/or repair itself autonomously)
7. Biologically-inspired sensor fusion & sensory-guided motor control
8. Portability (ability to be effortlessly mobile with no compromise of function)

Specific Example: A.1 Material Science Research for TransHab

NASA is considering an inflatable space transport habitat, called TransHab. TransHab was originally envisioned to be the pressurized (human living space) portion of a Mars transit vehicle. The basic design and technology used in the TransHab are applicable for both in-space and planetary surface habitats. When deployed on the International Space Station (ISS), TransHab will provide a habitable volume three times larger than standard ISS modules, yet still be launched on the Shuttle. TransHab will provide facilities for sleeping, eating, cooking, personal hygiene, exercise, entertainment, storage, and a radiation storm shelter.

The following are Materials Science requirements associated with TransHab. These requirements may be addressed by biology-inspired approaches:

- Atmosphere containment barriers (bladder) for human life support using thin light weight bladder materials having very low gas (air) permeation rates AND high damage (flex, tear) tolerance.
- Enhanced human radiation protection through the development of light-weight soft goods with high radiation protection characteristics.
- Development of laminating techniques and industry base for laminating various reinforcing scrims (Kevlar, Nylon, etc.) to thin polyethylene films for increased damage tolerance of inflatable bladders needed for long duration space missions.
- Development of manrated innerliners used in inflatables with improved human factors qualities: flame retardant, acoustic absorption, low toxicity, easy cleaning, & appropriate optical characteristics.

- Development of antibacterial processes for non-woven (felt) softgoods to prevent bacterial growth in materials used in the interiors of human tended modules.
- Development of materials which can more efficiently store propellant.

Specific Example: A.2 Materials Research for Planetary Surface Vehicle.

A Planetary Surface Vehicle will have wheels composed of a fabric material. This fabric must be a gas impermeable or near impermeable fabric that is light, abrasion and puncture resistant to Mars surface roughness, bondable or otherwise seamable into bladders that remain flexible at Mars surface temperatures, and resistant to Mars surface solar radiation degradation for a period of at least one year. A one-sheet coverage is needed; that is, it should be able to perform tubeless. It may be composed of multi-layer laminates as long as it retains flexibility with the properties above. It should have good sheer strength and resist stress creep and seam pullout. The application is an inflatable wheel of bladders, between which Mars atmospheric gas is moved to propagate rolling motion. Pressures across bladder walls will be dependent on the application and size, but will generally be less than thirty millibar.

B. Human-Centered Systems

The emerging concept of "human-centered systems" represents a significant shift in thinking about information technology in general, and about intelligent machines in particular. It embodies a "systems view," in which the interplay between human thought and action, and technological systems are understood as inextricably linked and equally important aspects of analysis, design, and evaluation. Human-centered systems focus on melding computer and human capabilities together into a system that synergistically exploits the capabilities and performance of each toward a specified goal or objective. Designers of human-centered systems typically work to understand the cognitive, computational, and social elements of the task, while exploiting biology and/or psychology to build a human/machine system that can solve the problem.

In the human-centered computing paradigm, determining what, when, and how much to automate becomes a central issue. Rather than the technology-centered goal of replacing humans completely or placing them only in occasional monitoring roles, often called “strong but silent automation,” it is now recognized that there is a need for a tightly coupled partnership between man and machine in which collaboration is the key. The human-centered systems approach is to amplify and extend human capability, not necessarily replace it. To develop an optimal system, designers and developers must join with human factors engineers, cognitive scientists, and others, to devise systems based on accurate data and validated models of human-machine interaction in authentic task environments. Proposals are solicited for space systems technologies that exploit human biology and psychology in the pursuit of development of greatly improved human-machine systems. NASA is soliciting proposals for research and development in some or all of the following areas:

1. Cognitive task analysis research
2. Innovative human/machine interfaces (e.g., haptics)
3. Personal digital assistants & wearable computing research
4. Just-in-time training systems and pedagogically-motivated browsers
5. Human-centered systems to ameliorate problems, such as space motion sickness, spatial disorientation, etc.
6. Natural language understanding systems
7. Performance support systems research
8. Knowledge acquisition & design knowledge capture research
9. Research on multi-person performance modeling

C. References

1. **National Research Council (NRC) Report: Biomolecular Self-Assembling Materials**, 1996. (see http://www.nap.edu/readingroom/books/bmm/)

2. **National Research Council (NRC) Report: Workshop on Biology-Based Technologies**, October 21, 1997. (see http://www.nap.edu/readingroom/books/bbt/)

IV. Proposal Evaluation and Awards Selection Process

The following information is specific to this NRA and **supersedes** the information contained in Sections I and J of Appendix C, *Instructions for Responding to NASA Research Announcements.*

All proposals must comply with the general requirements of the Announcement. Upon receipt, proposals will be reviewed for compliance with the requirements of this Announcement. This includes:

- Submission of complete proposals on or before the due date specified in this Announcement (see Section V, Part F of this Appendix).
- Responsiveness to technology areas in this Announcement.
- Submission of a complete proposal including a project description that is not more than 25 pages in length (see Instructions, Appendix B).
- Where relevant, submission of appropriate Institutional Review Board (IRB) or Animal Care and Use Committee (ACUC) certification for all proposals using human or animal test subjects. Certification must be specific to the proposal. NASA shall require current IRB or ACUC certification prior to award (see Special Matters, Appendix B of this Announcement). If IRB or ACUC review is unavoidably delayed beyond the submission of the application, enter "Pending" on line 9b or 10b of Form A. The certification must be received within 30 days after the due date for which the application is submitted. If certification is not received within 30 days after the application due date, the application will be considered incomplete. For additional information relative to IRB or ACUC approval and definitions of "human subjects" and "vertebrate animals," see Application for a Public Health Service Grant (PHS 398) at the web site:
  http://www.nih.gov/grants/funding/phs398/phs398.html
- Submission of a budget that is within the guidelines specified in this Announcement and is for a funding period not exceeding three years in duration (see Section V, Part A of this Appendix).
- Proposals that are revised versions of proposals previously submitted to NASA must be clearly marked as such and must contain an explanation of how the revised proposal has addressed criticisms from previous NASA review (see Instructions, Appendix B).
- Submission of all other appropriate forms as required by this NASA Research Announcement (refer to Checklist for Proposers, Form H, Appendix B).

Note: At NASA's discretion, non-compliant proposals may be withdrawn from the review process and returned to the proposer without further review.

The overall review process for each proposal submitted in response to this Announcement will include the following factors:

- Intrinsic scientific or technical merit including degree of innovation
- Feasibility of implementation (where relevant)
- Relevance to NASA programs
- Cost

The most important factor in the evaluation is intrinsic scientific or technical merit, followed by feasibility of implementation (where relevant), relevance to NASA programs, and cost.

Compliant proposals will undergo a three-tiered review process consisting of: a merit review, a feasibility of implementation review (where relevant), and an evaluation of programmatic relevance and cost.

A. Merit Review

The **first review tier** will be a merit review by a panel of scientific and/or technical experts. The number and diversity of experts required will be determined by the response to this NRA and by the variety of disciplines represented in the proposals relevant to the research emphases described in Section III of this Appendix. The merit review panel will assign ***a score from 0-100*** or a score of "not recommended for further consideration" based upon the intrinsic scientific or technical merit of the proposal. This score will reflect the consensus of the panel.

The score assigned by this panel ***will not be affected by the cost of the proposed work nor will it reflect the programmatic relevance of the proposed work to NASA***. However, the panel will be asked to include in their critique of each proposal any comments they may have concerning the proposal's budget and relevance to NASA.

Evaluation of intrinsic merit of the proposal includes consideration of the following in order of importance:

1. **Innovation:** Does the project employ novel concepts, approaches or methods? Are the aims original and innovative? Does the project challenge existing paradigms or develop new methodologies or technologies?
2. **Significance:** Does this study address an important problem? If the aims of the application are achieved, how will scientific knowledge or technology be advanced? What will be the effect of these studies on the concepts, methods or products that drive this field?
3. **Approach:** Are the conceptual framework, design, methods, and analyses adequately developed, well integrated, and appropriate to the aims of the project? Is the proposed approach likely to yield the desired results? Does the applicant acknowledge potential problem areas and consider alternative tactics? Is the proposal high risk and high payoff?
4. **Investigator:** Is the investigator appropriately trained and well suited to carry out this work? Is the work proposed appropriate to the experience level of the principal investigator and any co-investigators? Is the evidence of the investigator's productivity satisfactory?
5. **Environment:** Does the scientific environment in which the work will be performed contribute to the probability of success? Do the proposed experiments take advantage of unique features of the scientific environment or employ useful collaborative arrangements? Is there evidence of institutional support?

B. Feasibility of Implementation Review

The **second tier of review** (where relevant) will be an evaluation of the feasibility of implementation of the proposed work. This review will be conducted by an engineering and technical review team assembled by NASA, and will evaluate the feasibility of implementing the proposed projects utilizing available flight and/or ground facilities.

C. Evaluation of Programmatic Relevance and Cost

The **third tier of review** is of two factors: relevance and cost. This review will be conducted by NASA program scientists and managers, who will evaluate the programmatic relevance and cost of each proposal. Evaluation of the cost of a proposed effort includes consideration of the realism and reasonableness of the proposed cost and the relationship of the proposed cost to available funds. Programmatic relevance will include an evaluation of how the proposed work may help achieve an appropriate balance of the research areas addressed in this Announcement.

D. Development of Selection Recommendation

The information resulting from these three levels of review will in turn be used to prepare a **selection recommendation** developed by NASA program scientists and managers. This recommendation will be based on:

1. The score for merit from the peer review panel.
2. The results of the feasibility of implementation review (if applicable).
3. The programmatic relevance and cost of each proposal.

This **selection recommendation** will be presented by NASA program scientists and managers to the Associate Administrator of the Office of Life and Microgravity Sciences and Applications. Selection for funding will be made by the Associate Administrator of the Office of Life and Microgravity Sciences and Applications.

V. Program Management Information

A. Type of Awards to be Made

Funding increment:	One year at a time
Funding duration:	One to three years, depending on proposal requirement, review panel recommendation, and continuing contribution of the activity
Direct and Indirect Costs:	NASA does not provide separate funding for direct and indirect costs; thus, the amount of the award requested is the total of all costs submitted in the proposed budget
Number awarded:	Approximately 25 expected, depending on number received, review panel recommendation, and available funding
Average funding:	$150,000 per year
Funding range:	$15,000 to $350,000 per year

Role of NASA Field Centers

The NASA Biology-Inspired Technologies field center with primary programmatic responsibility will have a primary role in oversight of these awards and will be responsible, with OLMSA, for annually evaluating their progress and out-year plans.

B. Eligibility

All categories of institutions are eligible to submit proposals in response to this NRA. Principal Investigators may collaborate with universities, Federal Government laboratories, the private sector, and state and local government laboratories. In all such arrangements, the applying entity is expected to be responsible for administering the project according to the management approach presented in the proposal.

The applying entity must have in place a documented base of ongoing high quality research in science and technology or in those areas of science and engineering clearly relevant to the specific programmatic objectives and research emphases indicated in this Announcement. Present or prior support by NASA of research or training in any institution or for any investigator is not a prerequisite to submission of a proposal or a competing factor in the selection process.

All categories of institutions are eligible to submit proposals in response to this NRA, but only approved proposals from U.S. institutions will be selected for funding.

C. Foreign Proposals

Although NASA does not fund proposals from non-U.S. entities, NASA will accept for review proposals from non-U.S. entities that require use of NASA facilities. Such proposals should not include a cost plan. Proposals from non-U.S. entities and U.S. proposals that include non-U.S. participation must be endorsed in writing by the respective government agency or funding/sponsoring institution in the country from which the non-U.S. participant is proposing. This endorsement must indicate that:

1. The proposal merits careful consideration by NASA, and
2. If the proposal is selected, sufficient funds will be made available by that country or agency to undertake the activity as proposed.

U.S. co-investigators who are collaborating on non-U.S. proposals must ensure that their scientific role is clearly delineated in the proposal, that their expertise is shown to make a substantial contribution, and that their funding requirements (and only their funding requirements) are included in the proposal.

All proposals must be typewritten in English. All non-U.S. proposals will undergo the same evaluation and selection process as those originating in the U.S. Non-U.S. proposals and U.S. proposals that include non-U.S. participation must follow all other guidelines and requirements described in this NRA. All proposals must be received by the established closing date. Those received after the closing date will be treated in accordance with NASA's provisions for late proposals. Successful and unsuccessful proposers will be contacted directly by the NASA Program Office coordinating this Announcement. Copies of these letters will be sent to the sponsoring government agency.

Should a proposal from a non-U.S. entity or a U.S. proposal with non-U.S. participation be selected, NASA will arrange with the non-U.S. sponsoring agency for the proposed participation on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency will each bear the cost of discharging its respective responsibilities.

D. Program Reporting

It is expected that results from funded research will be submitted to peer-reviewed journals as the work progresses. Only published papers that acknowledge NASA's support and identify the grant or contract will be counted as resulting from the research project and used to evaluate its productivity.

Annual Reporting Investigators will be expected to provide NASA with annual summary information. This information will consist primarily of:

- an abstract
- a bibliographic list
- copies of publications
- a statement of progress

This information will be made available to the scientific community. It will also serve as the basis for determining the degree of progress of the project.

Annual Task Book Reporting The NASA Office of Life and Microgravity Sciences and Applications publishes two comprehensive annual documents titled *Life Sciences Program Tasks and Bibliography* (or Life Sciences Task Book) and *Microgravity Research Division Tasks and Bibliography* (or Microgravity Task Book) which include descriptions of all peer-reviewed activities funded by the respective divisions during the previous fiscal year. The Task Books are invaluable sources of information for NASA as well as the scientific and technical communities.

Investigators are required to provide Task Book information to their respective division on an annual basis. Please note that this requirement is in addition to the annual report which investigators are required to submit at the end of each funding cycle. Supplying the requested information for a Task Book does NOT fulfill the requirement for the annual report. Unlike the annual report, information requested for a Task Book must be for the government's fiscal year rather than the project funding cycle and brief.

The information requested for inclusion in the Task Books consists primarily of:

- a brief statement of task objective
- a brief statement of task description
- a brief statement of task significance
- an abstract
- a brief statement of progress during the fiscal year
- a brief statement of benefits of the research with respect to life on Earth
- a bibliographic list for the fiscal year
- a copy or reprint of each publication listed in the bibliography for the fiscal year

Note that, although these publications will be made available to the general scientific community, they are not substitutes for traditional scientific reporting in journals and elsewhere.

Final Report A final report is required which shall include all peer-reviewed publications.

E. Other Considerations

Travel If travel is planned, the proposal must include travel funds for the following:

- Annual NASA meeting
- Presentation at professional society meetings

Resident Research Associates Intramural investigators who plan to request Resident Research Associate (RRA) postdoctoral fellows supported by the NASA-National Research Council program should include this in their budget summary and list of personnel.

F. Letter of Intent and Proposal Submission Information

Letters of Intent To facilitate proposal processing, potential Principal Investigators are requested to confirm plans to submit a proposal responding to this Announcement by sending a ***letter of intent (LOI) to propose***, **by *December 15, 1998 by 4:30 PM EST*.** The letter of intent, which should be no more than two pages, should contain:

- The name, affiliation, address, and telephone number of a single principal investigator
- The names and affiliations of all co-investigators
- Identification of the research emphasis described in this Announcement that is most closely aligned with your proposal
- A descriptive title of the research or technical proposal
- A brief yet thorough summary describing the proposed research and clearly indicating the general scientific/technical objectives of the research
- The major participating institutions
- Up to six (6) key words that best describe the research area of the pending proposal

LOIs should be submitted via the World-Wide-Web (WWW) at:

http://peer1.idi.usra.edu/expro/loi/98_HEDS_04_loi.cfn

If you do not have access to the WWW, you may submit an LOI via e-mail to:

loi@hq.nasa.gov

The subject heading of the e-mail message should read "LOI NRA 98-HEDS-04."
If you do not have acces to e-mail, you may submit an LOI by U.S. Postal Service or commercial delivery in the same manner as proposals.

Proposals An original signed proposal, plus twenty-five (25) complete copies of that proposal and a 3.5-inch computer disk (containing an electronic copy of the Principal Investigator's name, address, telephone and fax numbers, e-mail address and the complete project title and abstract, as provided on Form B) in either Macintosh or PC format ***must be received February 3, 1999 by 4:30 PM EST*.**

Proposals and Letters of Intent mailed through the U.S. Postal Service by express, first class, registered, or certified mail are to be sent to the following address:

NASA c/o Information Dynamics, Inc.
SUBJECT: NASA OLMSA Research Proposal
300 D Street, SW
Suite 801
Washington, DC 20024

Proposals and Letters of Intent hand delivered or sent by commercial delivery or courier services are to be delivered to the above address between the hours of 8:00 AM and 4:30 PM EST. The telephone number (202) 479-2609 may be used when required for reference by delivery services.

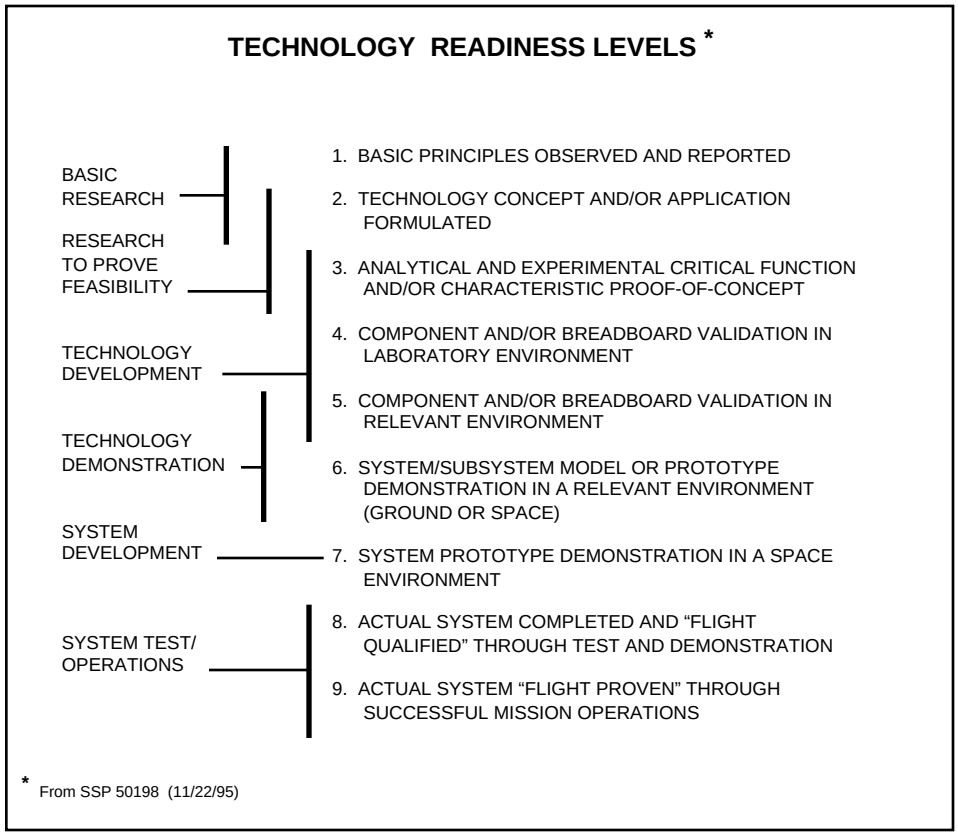
Note that Information Dynamics, Inc. (IDI) cannot receive deliveries on Saturdays, Sundays, or Federal holidays.

G. Proposal Schedule

The following schedule is planned for the acquisition of investigations under this Announcement:

Letter of Intent to Propose Due	December 15, 1998
Proposal Due	February 3, 1999
Selection Announcement	May 1999
Initial Funding Available	June 1999

H. Technology Readiness Levels



APPENDIX B
NRA 98-HEDS-04

Instructions for Proposal Preparation and Required Application Forms

This section contains the general instructions for proposal preparation and the specific forms required by proposers responding to this Announcement. This section is specific to this NRA and supercedes the information contained in Appendix C. The forms at the end of this section include the following:

Form A	Solicited Proposal Application
Form B	Proposal Abstract
Form D	Biographical Sketch
Form E	Other Support
Form F	Detailed Budget, First Year
Form G	Detailed Budget, Entire Project Period
Form H	Checklist for Proposers

NOTE: There is no Form C associated with this Announcement.

Instructions for Proposal Preparation

All proposals must include each of the forms provided in this Appendix as part of the complete submission, with the exception of Forms F and G, which are not required for some non-U.S. proposals (see the form-specific instructions included in this Appendix).

The proposal must include the following material, in this order:

1. Cover Page: Solicited Proposal Application (Form A), including certification of compliance with U.S. code (if applicable)*
2. Proposal Abstract (Form B)
3. Proposal Title Page, with Notice on Restriction on Use and Disclosure of Proposal Information, if any
4. Project Description Preface (Revised Proposals only)
5. Project Description
6. Management Approach

7. Letter of Assurance of Foreign Support (if applicable)
8. Biographical Sketch (Form D)
9. Other Support (Form E)
10. Facilities and Equipment
11. Special Matters (specific information on animal or human subjects protocol approval required, if applicable)*
12. Detailed Budget, 12 Month (Form F)
13. Detailed Budget, Entire Project Period (Form G)
14. Supporting Budgetary Information
15. Checklist for Proposers (Form H)
16. Appendices, if any
17. Computer diskette (3.5 inch, Macintosh or PC format) containing an electronic copy of the principal investigator's name, address, telephone and fax numbers, e-mail address, and the complete project title and abstract as provided on Form B

* One signed original required

The Project Description Section is limited to 25 pages. Any pages in this section beyond 25 will not be reviewed. There is no specific page limitation on other sections of submitted proposals. However, every effort should be made to keep proposals as brief as possible. The name of the Principal Investigator should appear in the upper right hand corner of each page of the proposal, except on the forms in this Appendix where special places are provided for this information. Note that the proposal must specify the period of performance for the work described; periods of performance may be for any duration up to three (3) years but should be suitable for the project proposed.

(1) Cover Page: Solicited Proposal Application (Form A)

All of the information requested on Form A must be provided, and one original signature version of this form should be submitted. This form meets the requirements of the transmittal memo described in Appendix C, Section C (1).

For Item (7) on this form, new means that a proposal for this project has not been submitted to NASA in 1996 or 1997, renewal means that this proposal is for the continuation of a currently funded task beyond the term of the funded proposal, and revised means that this proposal represents a revision of a proposal submitted to NASA and reviewed in 1996, 1997, or 1998, but not funded. A proposal previously submitted but not funded should be termed revised even if the original Principal Investigator has changed. Renewal and revised applications should contain special material described in the Project Description section below.

Note: Items (9) and (10) on Form A require assurance of compliance with human subject or animal care provisions of NASA regulations (see Special Matters section below). If IRB or ACUC review is unavoidably delayed beyond the submission of the application, enter "Pending" on line 9b or 10b in Form A. Applicants should be aware that proposal review will not be undertaken without prior assurance of compliance.

(2) Proposal Abstract (Form B)

The information requested on this form is essential to the review of the proposal. It determines how the application will be evaluated and which program manager(s) will receive the final review materials for possible inclusion in one of the research programs of the Office of Life and Microgravity Sciences and Applications.

(3) Proposal Title Page

The title page should contain the project title, name and address of the submitting institution, the name, address and telephone number of the Principal Investigator, and the names and institutions of any co-investigators. It is NASA policy to use information contained in proposals for evaluation purposes only. While this policy does not require that the proposal bear a restrictive notice, offerors or quoters should, in order to maximize protection of trade secrets or other information that is commercial or financial and confidential or privileged, place the following notice on the Title Page of the proposal and specify the information subject to the notice by inserting appropriate identification, such as page numbers, in the notice. In any event, information (data) contained in proposals will be protected to the extent permitted by law, however NASA assumes no liability for use and disclosure of information not made subject to the notice.

NOTICE

Restriction on Use and Disclosure of Proposal Information

The information (data) contained in [insert page numbers or other identification] of this proposal constitutes a trade secret and/or information that is commercial or financial and confidential or privileged. It is furnished to the Government in confidence with the understanding that it will not, without permission of the offeror, be used or disclosed other than for evaluation purposes; provided, however, that in the event a contract (or other agreement) is awarded on the basis of this proposal the Government shall have the right to use and disclose this information (data) to the extent provided in the contract (or other agreement). This restriction does not limit the Government's right to use or disclose this information (data) if obtained from another source without restriction.

(4) Project Description Preface (Revised Proposals only)

Revisions of 1996, 1997, or previous 1998 submissions to the NASA Office of Life and Microgravity Sciences and Applications must include a preface to the project description. This preface should be two to three pages in length and must contain clearly notated responses to the criticisms of the previous review. The pages in the preface will not count toward the 25 page limit of the project description. Revised proposals require further notation as described in the next section of this Appendix. Note that revised applications that do not address the criticisms in the previous critique or do not include substantial revisions will be considered unresponsive and will be returned without review.

(5) Project Description

The length of the Project Description section of the proposal should not exceed 25 pages using regular (12 point) type. **Pages beyond 25 will not be reviewed**. The proposal should contain sufficient detail to enable reviewers to make informed judgments about the overall merit of the proposed research and about the probability that the investigators will be able to accomplish their stated objectives with the resources requested and with their own resources. In addition, the proposal should indicate clearly the relationship between the proposed work and the research emphases defined in this Announcement.

Renewal applications (for competing renewal of currently funded activity) must include a progress report as an Appendix to the proposal, and should refer to this Appendix appropriately throughout the Project Description section.

Revised applications (revisions of 1996,1997, or previous 1998 submissions) must include appropriate notation in the project description. Applicants must highlight the changes they have

made in their research plan by appropriate bracketing, indenting, or changing of typography. Clearly present any work done since the prior version was submitted. Note that revised applications that do not address the criticisms in the previous critique (in a Preface as described above) or do not include substantial revisions will be considered unresponsive and will be returned without review.

(6) Management Approach

Each proposal must specify a single Principal Investigator who is responsible for carrying out the proposed project and coordinating the work of other personnel involved in the project. In proposals that designate several senior professionals as key participants in the research project, the management approach section should define the roles and responsibilities of each participant, and note the proportion of each individual's time to be devoted to the proposed research activity. The proposal must clearly and unambiguously state whether these key personnel have reviewed the proposal and endorsed their participation.

(7) Letter of Assurance of Foreign Support

Applications submitted by non-U.S. entities as well as applications with non-U.S. participation submitted by U.S. entities must include a written endorsement from the respective agency or funding/sponsoring institution (see Appendix A, Section V, Part C of this Announcement for details).

(8) Biographical Sketch (Form D)

The Principal Investigator is responsible for direct supervision of the work and must participate in the conduct of the research regardless of whether or not compensation is received under the award. A short biographical sketch of the Principal Investigator that includes his or her current position title and educational background, a list of principal publications, and a description of any exceptional qualifications must be included. Use Form D to describe the research and professional experience of each professional staff member. Concluding with present position, list, in chronological order, previous employment, experience, and honors. Include present membership on any Federal Government public advisory committee. List, in chronological order, the titles, all authors, and complete references to all publications during the past three years and to representative earlier publications pertinent to this application. If the list of publications in the last three years exceeds two pages, select the most pertinent publications. Do not exceed two pages. Omit social security numbers and other personal items which do not merit consideration in evaluation of the proposal. Provide similar biographical information on other senior professional personnel who will be directly associated with the project. Provide the names and titles of any other scientists and technical personnel associated substantially with the project in an advisory capacity. Universities should list the approximate number of students or other assistants, with information as to their level of academic attainment. Any special industry-university cooperative arrangements should be described.

(9) Other Support (Form E)

Use the format described in Form E to list other sources of research support (including active NASA support) for the proposed Principal Investigator and each of the proposed Co-Investigators. Please list all active support as well as any pending support.

(10) Facilities and Equipment

Describe the available facilities and major items of equipment specially adapted or suited to the proposed project, and any additional major equipment that will be required. Identify any government-owned facilities, industrial plant equipment, or special tooling that are proposed for use on the project. Provide evidence that such facilities or equipment will be made available if the applicant is successful in obtaining funding. Before requesting a major item of capital equipment, the proposer should determine if the sharing or loan of equipment already within the organization is a feasible alternative to purchase. Where such arrangements cannot be made, the proposal should so state. The need for items that can be typically used for research and non-research purposes should be explained.

(11) Special Matters

The Special Matters section must contain a statement from the proposer's institution which states that the proposed work will meet all Federal and local human subject requirements and animal care and use requirements, if applicable. Note that no animal subjects may be utilized unless specific information justifying and describing their use is included in the proposal. Policies regarding the protection of human research subjects in NASA-sponsored research are detailed in NASA Management Instruction (NMI) 7100.8B (Protection of Human Research Subjects), and animal care and use requirements are detailed in the NASA Code of Federal Regulations (CFR) 1232 (Care and Use of Animals in the Conduct of NASA Activities), both of which are available from the Office of Life and Microgravity Sciences and Applications, NASA Headquarters, Washington, DC 20546. Assurance of compliance with human subject or animal care provisions is required on Form A, to be submitted with each proposal. In addition, a letter signed by the chairperson of the Institutional Review Board (IRB) or institutional Animal Care and Use Committee (ACUC) or both, as appropriate, regarding approval of the experimental protocol, should be included with each copy of the proposal. If IRB or ACUC review is unavoidably delayed beyond the submission of the application, the certification must be received within 30 days after the due date for which the application is submitted. If certification is not received within 30 days after the application due date, the application will be considered incomplete. NASA shall require current IRB or ACUC certification prior to award. All U.S., non-NASA proposals providing ACUC approval must also contain the institution's Public Health Assurance number.

(12) Detailed Budget, 12 Month (Form F) and (13) Detailed Budget, Entire Project Period (Form G)

These forms must be submitted with each U.S. proposal, or with non-U.S. proposals that have a U.S. component for which NASA funding is sought. NASA intramural Principal Investigator's research budgets for all years are to be submitted in a full-cost mode in accordance with the NASA CFO, Enterprise Office and Center full-cost budget policy. Funds to support the Resident Research Assistant (RRA) Postdoctoral Program costs (e.g., stipend, travel, computer time, supplies, etc.) are to be budgeted within the NASA intramural Principle Investigator budget.

Foreign proposals with no U.S. component should not submit these forms.

(14) Supporting Budgetary Information

This section must include information that supports the costs submitted in Forms F and G. In this solicitation, the terms "cost" and "budget" are used synonymously. Sufficient proposal cost detail and supporting information are required; funding amounts proposed with no explanation (e.g., Equipment: $1,000, or Labor: $6,000) may cause delays in evaluation and award. Generally, costs will be evaluated as to realism, reasonableness, allowability, and allocation. The budgetary forms define the desired detail, but each category should be explained in this section. Offerors

should exercise prudent judgment in determining what to include in the proposal, as the amount of detail necessarily varies with the complexity of the proposal.

The following indicate the suggested method of preparing a cost breakdown:

Direct Labor

Labor costs should be segregated by titles or disciplines with estimated hours and rates for each. Estimates should include a basis of estimate such as currently paid rates or outstanding offers to prospective employees. This format allows the Government to assess cost reasonableness by various means including comparison to similar skills at other organizations.

Other Direct Costs

Please detail, explain, and substantiate other significant cost categories as described below:

a) Subcontracts: Describe the work to be contracted, estimated amount, recipient (if known), and the reason for subcontracting.
b) Consultants: Identify consultants to be used, why they are necessary, the time they will spend on the project, and the rates of pay (not to exceed the equivalent of the daily rate for Level IV of the Executive Schedule, exclusive of expenses and indirect costs).
c) Equipment: List separately. Explain the need for items costing more than $5,000. Describe basis for estimated cost. General purpose equipment is not allowable as a direct cost unless specifically approved by the NASA Grant Officer. Any equipment purchase requested as a direct charge must include the equipment description, how it will be used in the conduct of the basic research proposed, and why it cannot be purchased with indirect funds.
d) Supplies: Provide general categories of needed supplies, the method of acquisition, and estimated cost.
e) Travel: Describe the purpose of the proposed travel in relation to the grant and provide the basis of estimate, including information on destination and number of travelers where known.
f) Other: Enter the total of direct costs not covered by a) through e). Attach an itemized list explaining the need for each item and the basis for the estimate.

Indirect Costs

Indirect costs should be explained to an extent that will allow the Government to understand the basis for the estimate. Examples of prior year historical rates, current variances from those rates, or an explanation of other basis of estimates should be included. Where costs are based on allocation percentages or dollar rates, an explanation of rate and application base relationships should be given. For example, the base to which the General and Administrative (G&A) rate is applied could be explained as: application base equals total costs before G&A less subcontracts.

(15) Checklist for Proposers (Form H)

One copy of a completed version of this checklist should be attached to Form A of the original signed proposal.

(16) Appendices, if Any

Renewal applications (for competing renewal of currently funded activity) must include an appendix providing a Progress Report of the previously funded activity. This report should provide the beginning and ending dates for the period covered since the project was last reviewed competitively, and provide a list of all personnel who have worked on the project during this period (including dates of service and percentages of their appointments devoted to the project).

The report should also summarize the previous project's original goals and specific objectives, and provide a succinct account of published and unpublished results indicating progress toward their achievement. Changes in these objectives during the course of the project and a rationale for these changes should be presented. The importance of the findings should be summarized and discussed. Finally, a list should be provided of the titles and complete references to all publications, manuscripts submitted or accepted for publication, patents, invention reports, and other printed materials that have resulted from the project since it was last competitively reviewed.

Other appendices may be appropriate for particular proposals.

(17) Computer Diskette

A diskette (3.5 inch, Macintosh or PC format) should contain an electronic copy of the Principal Investigator's name, address, telephone and fax numbers, e-mail address, and the complete project title and abstract as provided on Form B.

THE REQUIRED APPLICATION FORMS

MUST BE DOWNLOADED SEPARATELY FROM

http://peer1.idi.usra.edu/peer_review/nra/98_HEDS_04.html

APPENDIX C
NRA 98-HEDS-04

Instructions For Responding To NASA Research Announcements

(JANUARY 1997)

A. General.

(1) Proposals received in response to a NASA Research Announcement (NRA) will be used only for evaluation purposes. NASA does not allow a proposal, the contents of which are not available without restriction from another source, or any unique ideas submitted in response to an NRA to be used as the basis of a solicitation or in negotiation with other organizations, nor is a pre-award synopsis published for individual proposals.

(2) A solicited proposal that results in a NASA award becomes part of the record of that transaction and may be available to the public on specific request; however, information or material that NASA and the awardee mutually agree to be of a privileged nature will be held in confidence to the extent permitted by law, including the Freedom of Information Act.

(3) NRA's contain programmatic information and certain requirements which apply only to proposals prepared in response to that particular announcement. These instructions contain the general proposal preparation information which applies to responses to all NRAs.

(4) A contract, grant, cooperative agreement, or other agreement may be used to accomplish an effort funded in response to an NRA. NASA will determine the appropriate instrument. Contracts resulting from NRA's are subject to the Federal Acquisition Regulation and the NASA FAR Supplement. Any resultant grants or cooperative agreements will be awarded and administered in accordance with the NASA Grant and Cooperative Agreement Handbook (NPG 5800.1).

(5) NASA does not have mandatory forms or formats for responses to NRA's; however, it is requested that proposals conform to the guidelines in these instructions. NASA may accept proposals without discussion; hence, proposals should initially be as complete as possible and be submitted on the proposers' most favorable terms.

(6) To be considered for award, a submission must, at a minimum, present a specific project within the areas delineated by the NRA; contain sufficient technical and cost information to permit a meaningful evaluation; be signed by an official authorized to legally bind the submitting organization; not merely offer to perform standard services or to just provide computer facilities or services; and not significantly duplicate a more specific current or pending NASA solicitation.

B. NRA-Specific Items. Several proposal submission items appear in the NRA itself: the unique NRA identifier; when to submit proposals; where to send proposals; number of copies required; and sources for more information. Items included in these instructions may be supplemented by the NRA.

C. Proposal Content. The following information is needed to permit consideration in an objective manner. NRAs will generally specify topics for which additional information or greater detail is desirable. Each proposal copy shall contain all submitted material, including a copy of the transmittal letter if it contains substantive information.

(1) *Transmittal Letter or Prefatory Material.*

(i) The legal name and address of the organization and specific division or campus identification if part of a larger organization;

(ii) A brief, scientifically valid project title intelligible to a scientifically literate reader and suitable for use in the public press;

(iii) Type of organization: e.g., profit, nonprofit, educational, small business, minority, women-owned, etc.;

(iv) Name and telephone number of the principal investigator and business personnel who may be contacted during evaluation or negotiation;

(v) Identification of other organizations that are currently evaluating a proposal for the same efforts;

(vi) Identification of the NRA, by number and title, to which the proposal is responding;

(vii) Dollar amount requested, desired starting date, and duration of project;

(viii) Date of submission; and

(ix) Signature of a responsible official or authorized representative of the organization, or any other person authorized to legally bind the organization (unless the signature appears on the proposal itself).

(2) *Restriction on Use and Disclosure of Proposal Information.* Information contained in proposals is used for evaluation purposes only. Offerors or quoters should, in order to maximize protection of trade secrets or other information that is confidential or privileged, place the following notice on the title page of the proposal and specify the information subject to the notice by inserting an appropriate identification in the notice. In any event, information contained in proposals will be protected to the extent permitted by law, but NASA assumes no liability for use and disclosure of information not made subject to the notice.

Notice

Restriction on Use and Disclosure of Proposal Information

The information (data) contained in [insert page numbers or other identification] of this proposal constitutes a trade secret and/or information that is commercial or financial and confidential or privileged. It is furnished to the Government in confidence with the understanding that it will not, without permission of the offeror, be used or disclosed other than for evaluation purposes; provided, however, that in the event a contract (or other agreement) is awarded on the basis of this proposal the Government shall have the right to use and disclose this information (data) to the extent provided in the contract (or other agreement). This restriction does not limit the Government's right to use or disclose this information (data) if obtained from another source without restriction.

(3) *Abstract*. Include a concise (200-300 word if not otherwise specified in the NRA) abstract describing the objective and the method of approach.

(4) *Project Description.*

(i) The main body of the proposal shall be a detailed statement of the work to be undertaken and should include objectives and expected significance; relation to the present state of knowledge; and relation to previous work done on the project and to related work in progress elsewhere. The statement should outline the plan of work, including the broad design of experiments to be undertaken and a description of experimental methods and procedures. The project description should address the evaluation factors in these instructions and any specific factors in the NRA. Any substantial collaboration with individuals not referred to in the budget or use of consultants should be described. Subcontracting significant portions of a research project is discouraged.

(ii) When it is expected that the effort will require more than one year, the proposal should cover the complete project to the extent that it can be reasonably anticipated. Principal emphasis should be on the first year of work, and the description should distinguish clearly between the first year's work and work planned for subsequent years.

(5) *Management Approach*. For large or complex efforts involving interactions among numerous individuals or other organizations, plans for distribution of responsibilities and arrangements for ensuring a coordinated effort should be described.

(6) *Personnel*. The principal investigator is responsible for supervision of the work and participates in the conduct of the research regardless of whether or not compensated under the award. A short biographical sketch of the principal investigator, a list of principal publications and any exceptional qualifications should be included. Omit social security number and other personal items which do not merit consideration in evaluation of the proposal. Give similar biographical information on other senior professional personnel who will be directly associated with the project. Give the names and titles of any other scientists and technical personnel associated substantially with the project in an advisory capacity. Universities should list the approximate number of students or other assistants, together with information as to their level of academic attainment. Any special industry-university cooperative arrangements should be described.

(7) *Facilities and Equipment.*

(i) Describe available facilities and major items of equipment especially adapted or suited to the proposed project, and any additional major equipment that will be required. Identify any Government-owned facilities, industrial plant equipment, or special tooling that are proposed for use. Include evidence of its availability and the cognizant Government points
of contact.

(ii) Before requesting a major item of capital equipment, the proposer should determine if sharing or loan of equipment already within the organization is a feasible alternative. Where such arrangements cannot be made, the proposal should so state. The need for items that typically can be used for research and non-research purposes should be explained.

(8) *Proposed Costs.*

(i) Proposals should contain cost and technical parts in one volume: do not use separate "confidential" salary pages. As applicable, include separate cost estimates for salaries and wages; fringe benefits; equipment; expendable materials and supplies; services; domestic and foreign travel; ADP expenses; publication or page charges; consultants; subcontracts; other miscellaneous identifiable direct costs; and indirect costs. List salaries and wages in appropriate organizational categories (e.g., principal investigator, other scientific and engineering professionals, graduate students, research assistants, and technicians and other non-professional personnel). Estimate all staffing data in terms of staff-months or fractions of full-time.

(ii) Explanatory notes should accompany the cost proposal to provide identification and estimated cost of major capital equipment items to be acquired; purpose and estimated number and lengths of trips planned; basis for indirect cost computation (including date of most recent negotiation and cognizant agency); and clarification of other items in the cost proposal that are not self-evident. List estimated expenses as yearly requirements by major
work phases.

(iii) Allowable costs are governed by FAR Part 31 and the NASA FAR Supplement Part 1831 (and OMB Circulars A-21 for educational institutions and A-122 for nonprofit organizations).

(9) *Security*. Proposals should not contain security classified material. If the research requires access to or may generate security classified information, the submitter will be required to comply with Government security regulations.

(10) *Current Support*. For other current projects being conducted by the principal investigator, provide title of project, sponsoring agency, and ending date.

(11) *Special Matters.*

(i) Include any required statements of environmental impact of the research, human subject or animal care provisions, conflict of interest, or on such other topics as may be required by the nature of the effort and current statutes, executive orders, or other current Government-wide guidelines.

(ii) Proposers should include a brief description of the organization, its facilities, and previous work experience in the field of the proposal. Identify the cognizant Government audit agency, inspection agency, and administrative contracting officer, when applicable.

D. Renewal Proposals.

(1) Renewal proposals for existing awards will be considered in the same manner as proposals for new endeavors. A renewal proposal should not repeat all of the information that was in the original proposal. The renewal proposal should refer to its predecessor, update the parts that are no longer current, and indicate what elements of the research are expected to be covered during the period for which support is desired. A description of any significant findings since the most recent progress report should be included. The renewal proposal should treat, in reasonable detail, the plans for the next period, contain a cost estimate, and otherwise adhere to these instructions.

(2) NASA may renew an effort either through amendment of an existing contract or by a new award.

E. Length. Unless otherwise specified in the NRA, effort should be made to keep proposals as brief as possible, concentrating on substantive material. Few proposals need exceed 15-20 pages. Necessary detailed information, such as reprints, should be included as attachments. A complete set of attachments is necessary for each copy of the proposal. As proposals are not returned, avoid use of "one-of-a-kind" attachments.

F. Joint Proposals.

(1) Where multiple organizations are involved, the proposal may be submitted by only one of them. It should clearly describe the role to be played by the other organizations and indicate the legal and managerial arrangements contemplated. In other instances, simultaneous submission of related proposals from each organization might be appropriate, in which case parallel awards would be made.

(2) Where a project of a cooperative nature with NASA is contemplated, describe the contributions expected from any participating NASA investigator and agency facilities or equipment which may be required. The proposal must be confined only to that which the proposing organization can commit itself. "Joint" proposals which specify the internal arrangements NASA will actually make are not acceptable as a means of establishing an agency commitment.

G. Late Proposals. A proposal or modification received after the date or dates specified in an NRA may be considered if doing so is in the best interests of the Government.

H. Withdrawal. Proposals may be withdrawn by the proposer at any time before award. Offerors are requested to notify NASA if the proposal is funded by another organization or of other changed circumstances which dictate termination of evaluation.

I. Evaluation Factors.

(1) Unless otherwise specified in the NRA, the principal elements (of approximately equal weight) considered in evaluating a proposal are its relevance to NASA's objectives, intrinsic merit, and cost.

(2) Evaluation of a proposal's relevance to NASA's objectives includes the consideration of the potential contribution of the effort to NASA's mission.

(3) Evaluation of its intrinsic merit includes the consideration of the following factors of equal importance:

(i) Overall scientific or technical merit of the proposal or unique and innovative methods, approaches, or concepts demonstrated by the proposal.

(ii) Offeror's capabilities, related experience, facilities, techniques, or unique combinations of these which are integral factors for achieving the proposal objectives.

(iii) The qualifications, capabilities, and experience of the proposed principal investigator, team leader, or key personnel critical in achieving the proposal objectives.

(iv) Overall standing among similar proposals and/or evaluation against the state-of-the-art.

(4) Evaluation of the cost of a proposed effort may include the realism and reasonableness of the proposed cost and available funds.

J. Evaluation Techniques. Selection decisions will be made following peer and/or scientific review of the proposals. Several evaluation techniques are regularly used within NASA. In all cases proposals are subject to scientific review by discipline specialists in the area of the proposal. Some proposals are reviewed entirely in-house, others are evaluated by a combination of in-house and selected external reviewers, while yet others are subject to the full external peer review technique (with due regard for conflict-of-interest and protection of proposal information), such as by mail or through assembled panels. The final decisions are made by a NASA selecting official. A proposal which is scientifically and programmatically meritorious, but not selected for award during its initial review, may be included in subsequent reviews unless the proposer requests otherwise.

K. Selection for Award.

(1) When a proposal is not selected for award, the proposer will be notified. NASA will explain generally why the proposal was not selected. Proposers desiring additional information may contact the selecting official who will arrange a debriefing.

(2) When a proposal is selected for award, negotiation and award will be handled by the procurement office in the funding installation. The proposal is used as the basis for negotiation. The contracting officer may request certain business data and may forward a model award instrument and other information pertinent to negotiation.

L. Cancellation of NRA. NASA reserves the right to make no awards under this NRA and to cancel this NRA. NASA assumes no liability for canceling the NRA or for anyone's failure to receive actual notice of cancellation.